Land Use Change: Extracts from the GRANIT Database

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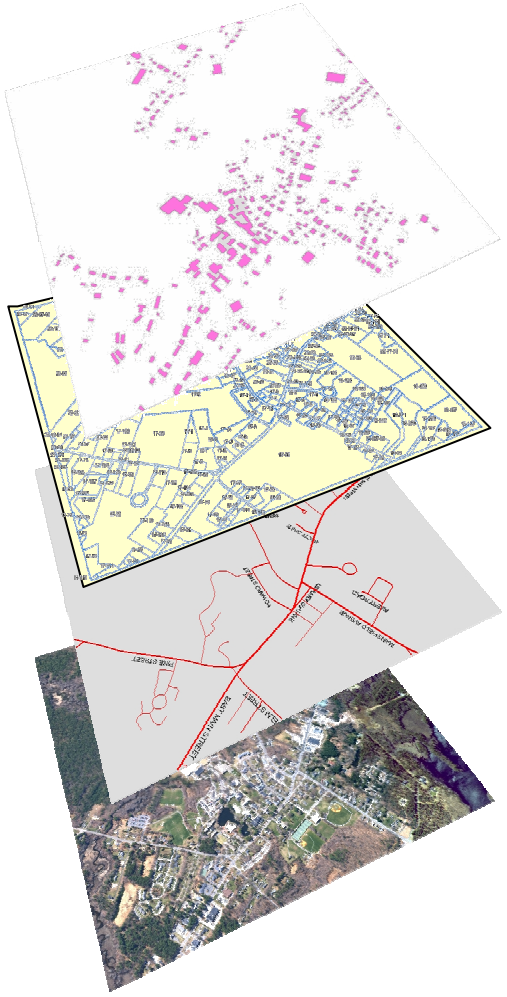
http://www.granit.unh.edu

Presented to:
Great Bay Siltation Commission
Sandy Point Discovery Center
March 6, 2008

What is GRANIT?

- Central GIS Data Clearinghouse at UNH Complex Systems Research Center
- Collaboration of Multiple Data Providers and Data Users
  - State government
  - Federal agencies
  - Regional planning agencies
  - Municipalities
  - Private sector
  - Non-profit sector
  - Academic community
- Multiple Funding Sources



GRANIT Mission

To promote the efficient use of New Hampshire's diverse resources by utilizing spatial information in an effective way and by providing geographic information and related tools to citizens and organizations

Core Activities:

- Data development/archiving/serving/distribution
- Coordination/standards development
- Spatial data analysis
- Training and technical support

GRANIT Data Overview

- Boundaries
- Hydrography
- Geodetic Control
- Transportation
- Terrain
- Environmental Factors
- Geology/Surficial Materials/Soils
- Land Cover/Land Use
- Photography/Imagery

Data Layer:	Source:
Surface Waters	USGS
Aquifers	USGS-Pembroke
Watersheds	DES
Wetlands-NWI	US F&WS
Well Inventory	DES
Floodplains	FEMA/CSRC

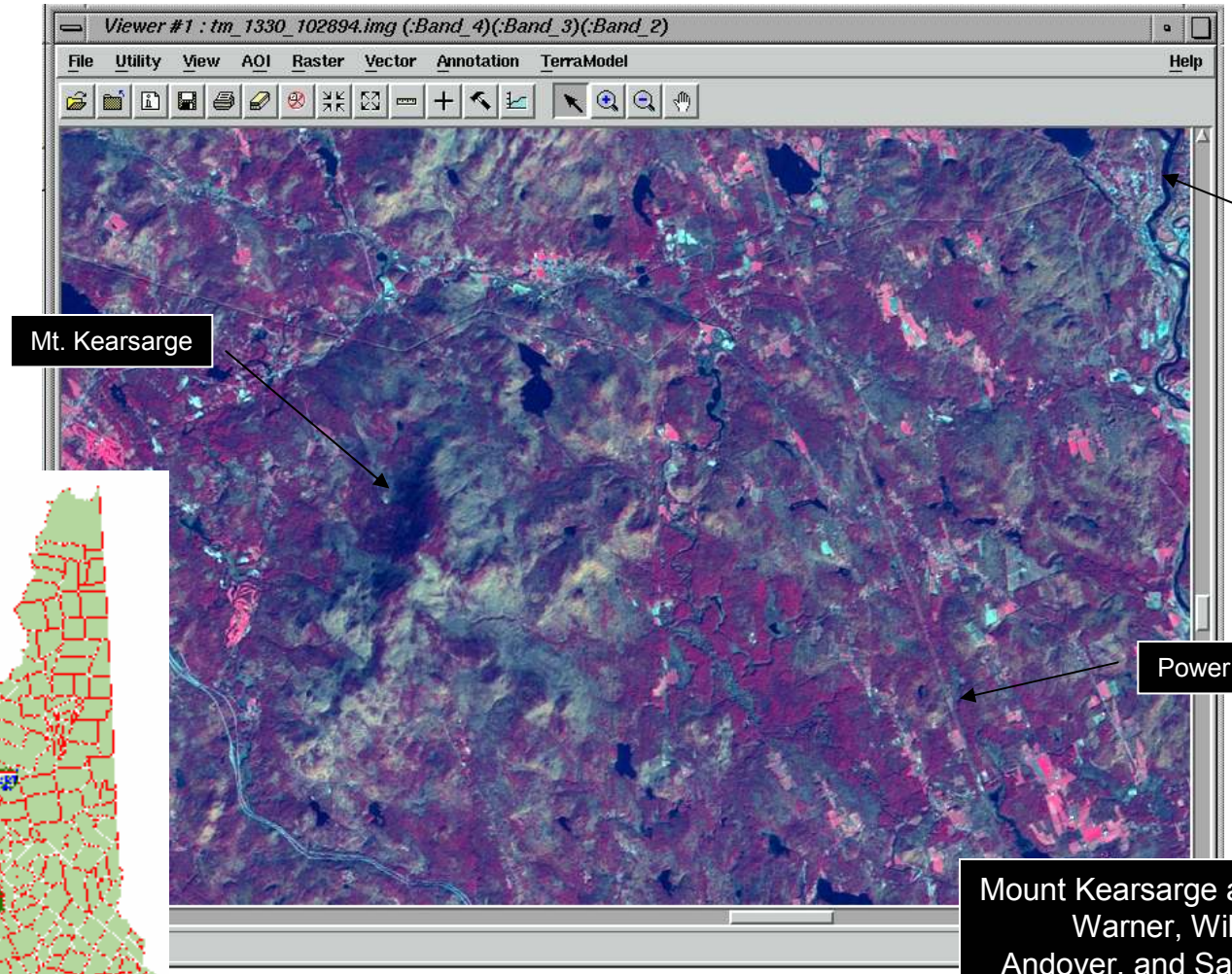
Key Parameters:

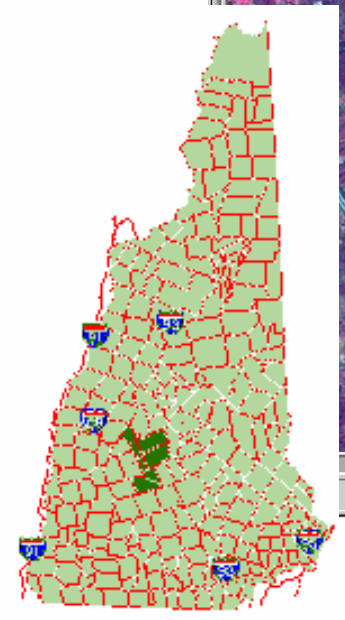
1:24,000 or larger scale
NH State Plane feet, NAD83
National Map Accuracy Standards

1. Generalized Land Cover

- Land cover mapped from Landsat Thematic Mapper imagery, 30-meter resolution
- Completed in 2001, based on imagery from late 1990's – early 2000's
- Funded by consortium including CICEET, NH Fish & Game, NH DRED
- Focus on vegetative categories

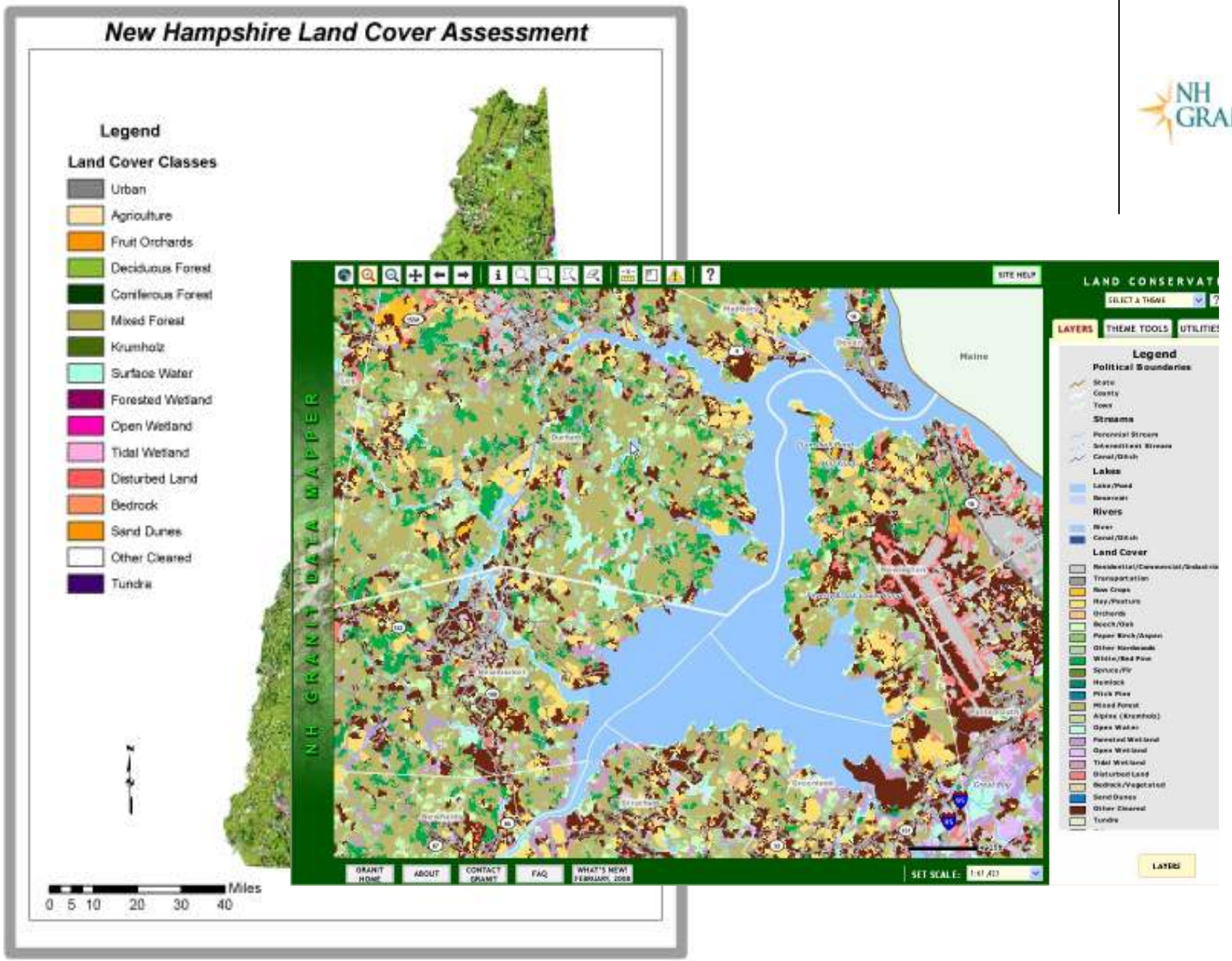
Source Satellite Imagery – Landsat Thematic Mapper





Land Cover Classes

Level 1		Level 2		Level 3	
1	Urban and Built-up Land	10	Built-up areas		
2	Active Agricultural Land	21	Cropland & pasture	211	Row crops
				212	Hay/ rotation/ permanent pasture
		22	Orchards, fruit, and ornamental horticulture	221	Fruit orchards
4	Forested	41	Deciduous	411	Beech
				412	Beech/ oak
				413	Oak
				414	Paper birch/ aspen
				419	Other hardwoods
		42	Conifer	421	White/ red pine
				422	Spruce/ fir
				423	Hemlock
				424	Pitch pine
				429	Other conifers
		43	Mixed forest		
		44	Alpine (krumholz)		
5	Water	50	Lakes, ponds, some rivers, or any other open water		
6	Wetlands	61	Forested wetlands		
		62	Non-forested wetlands		
		63	Tidal wetlands		
7	Cleared/ Other Open	71	Disturbed		
		72	Bedrock/ vegetated		
		73	Sand dunes		
		79	Cleared/ other open		
8	Tundra				


New Hampshire Land Cover Assessment
Legend
Land Cover Classes
Urban
Agriculture
Fruit Orchards
Deciduous Forest
Coniferous Forest
Mixed Forest
Krumholtz
Surface Water
Forested Wetland
Open Wetland
Tidal Wetland
Disturbed Land
Bedrock
Sand Dunes
Other Cleared
Tundra
Miles
0 5 10 20 30 40
NH GRANIT DATA MAPPER
SITE HELP
LAND CONSERVAT
SELECT A THEME
LAYERS
THEME TOOLS
UTILITIES
Legend
Political Boundaries
State
County
Town
Streams
Perennial Stream
Intermittent Stream
Canal/Ditch
Lakes
Lake/Pond
Reservoir
Rivers
River
Canal/Ditch
Land Cover
Transportation
Row Crops
Hay/Pasture
Orchards
Beech/Oak
Paper Birch/Aspen
White/Red Pine
Spruce/Fir
Hemlock
Mixed Forest
Open Water
Open Wetland
Tidal Wetland
Disturbed Land
Sand Dunes
Other Cleared
Tundra
Maine
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WHAT'S NEW! FEBRUARY, 2008
SET SCALE:
LAYERS

Land Cover Acreage Summary

Land Cover Class		County										
		Belknap	Carroll	Cheshire	Coos	Grafton	Hillsborough	Merrimack	Rockingham	Strafford	Sullivan	New Hampshire
Residential/ Commercial/ Industrial	Acres	4,704	5,348	6,956	4,002	9,434	28,137	13,397	14,210	4,344	4,556	95,089
	%	1.6%	0.8%	1.5%	0.3%	0.8%	4.9%	2.2%	3.1%	1.8%	1.3%	1.6%
Transportation	Acres	9,704	11,227	13,219	8,880	19,509	33,615	21,685	29,591	11,780	7,777	166,987
	%	3.2%	1.8%	2.8%	0.8%	1.7%	5.9%	3.5%	6.4%	4.8%	2.2%	2.8%
Total: Developed	Acres	14,408	16,576	20,175	12,882	28,943	61,752	35,082	43,801	16,124	12,333	262,077
	%	4.8%	2.6%	4.3%	1.1%	2.6%	10.8%	5.7%	9.4%	6.6%	3.5%	4.4%
Row Crops	Acres	39	305	2,397	1,934	3,344	1,065	3,266	506	503	2,167	15,882
	%	0.1%	0.0%	0.5%	0.2%	0.3%	0.2%	0.5%	0.1%	0.2%	0.6%	0.3%
Hay/ Pasture	Acres	13,075	10,468	24,212	19,058	40,643	31,418	34,190	19,636	10,535	20,676	223,909
	%	4,3%	1.6%	5.2%	1.6%	3.6%	5.5%	5.6%	4.2%	4.3%	5.9%	3.8%
Orchards	Acres	181	31	15	0	189	2,532	790	1,853	277	62	5,929
	%	0.1%	0.0%	0.0%	0.0%	0.0%	0.4%	0.1%	0.4%	0.1%	0.0%	0.1%
Total: Agriculture	Acres	13,652	10,804	26,624	20,992	44,175	35,014	38,246	21,995	11,314	22,904	245,719
	%	4.5%	1.7%	5.7%	1.8%	3.9%	6.1%	6.3%	4.7%	4.6%	6.5%	4.1%

Accuracy Assessment

Level 1

Land Cover Class		Producer's Accuracy	User's Accuracy
Developed	100	93.6%	91.3%
All Agriculture	200	96.2%	95.6%
Forest	400	99.0%	97.5%
Water	500	100.0%	100.0%
Wetland	600	94.3%	95.0%
Cleared/Other Open	700	89.9%	94.4%
Tundra	800	100.0%	100.0%
Overall Accuracy		95.9%	

Level 2

Land Cover Class		Producer's Accuracy	User's Accuracy
Resid./Comm./Indus.	110	86.9%	88.3%
Transportation	140	100.0%	85.0%
Agriculture	210	95.0%	95.8%
Orchards	221	97.4%	92.5%
Deciduous Forest	410	90.7%	94.8%
Coniferous Forest	420	97.3%	81.9%
Mixed Forest	430	39.7%	62.5%
Alpine (Krumholz)	440	100.0%	80.0%
Water	500	100.0%	100.0%
Forested Wetland	610	74.3%	86.7%
Open Wetland	620	88.2%	75.0%
Tidal Wetland	630	100.0%	100.0%
Disturbed	710	90.0%	90.0%
Bedrock/ Veg.	720	100.0%	100.0%
Sand Dunes	730	100.0%	100.0%
Other Cleared	790	82.4%	93.3%
Tundra	810	100.0%	100.0%
Overall Accuracy		88.4%	

Level 3

Land Cover Class		Producer's Accuracy	User's Accuracy
Resid./Comm./Indus.	100	86.9%	88.3%
Transportation	140	100.0%	85.0%
Row Crops	211	94.6%	88.3%
Hay/Pasture	212	84.6%	91.7%
Orchards	221	97.4%	92.5%
Beech/Oak	412	68.1%	53.3%
Paper Birch/ Aspen	414	28.6%	28.6%
Other Hardwood	419	53.2%	70.0%
White/Red Pine	421	90.7%	81.7%
Spruce/Fir	422	93.8%	80.4%
Hemlock	423	95.1%	65.0%
Pitch Pine	424	100.0%	97.5%
Mixed Forest	430	39.7%	62.5%
Alpine (Krumholz)	440	100.0%	80.0%
Water	500	100.0%	100.0%
Forested Wetland	610	74.3%	86.7%
Open Wetland	620	88.2%	75.0%
Tidal Wetland	630	100.0%	100.0%
Disturbed	710	90.0%	90.0%
Bedrock/ Veg.	720	100.0%	100.0%
Sand Dunes	730	100.0%	100.0%
Other Cleared	790	82.4%	93.3%
Tundra	810	100.0%	100.0%
Overall Accuracy		82.2%	

Producer's accuracy - percentage of occurrences for which a reference/field site was assigned the correct map label. Errors of omission.

User's accuracy - percentage of occurrences for which a map label correctly described the reference/field site. Errors of commission.

Generalized Land Cover

- Strengths:
  - Statewide, synoptic view
  - Cost-effective
  - Can be generated for dates after early 1970's to facilitate change detection
  - Useful for watershed-level characterizations, wildlife habitat management, forest inventory and management, fragmentation estimates

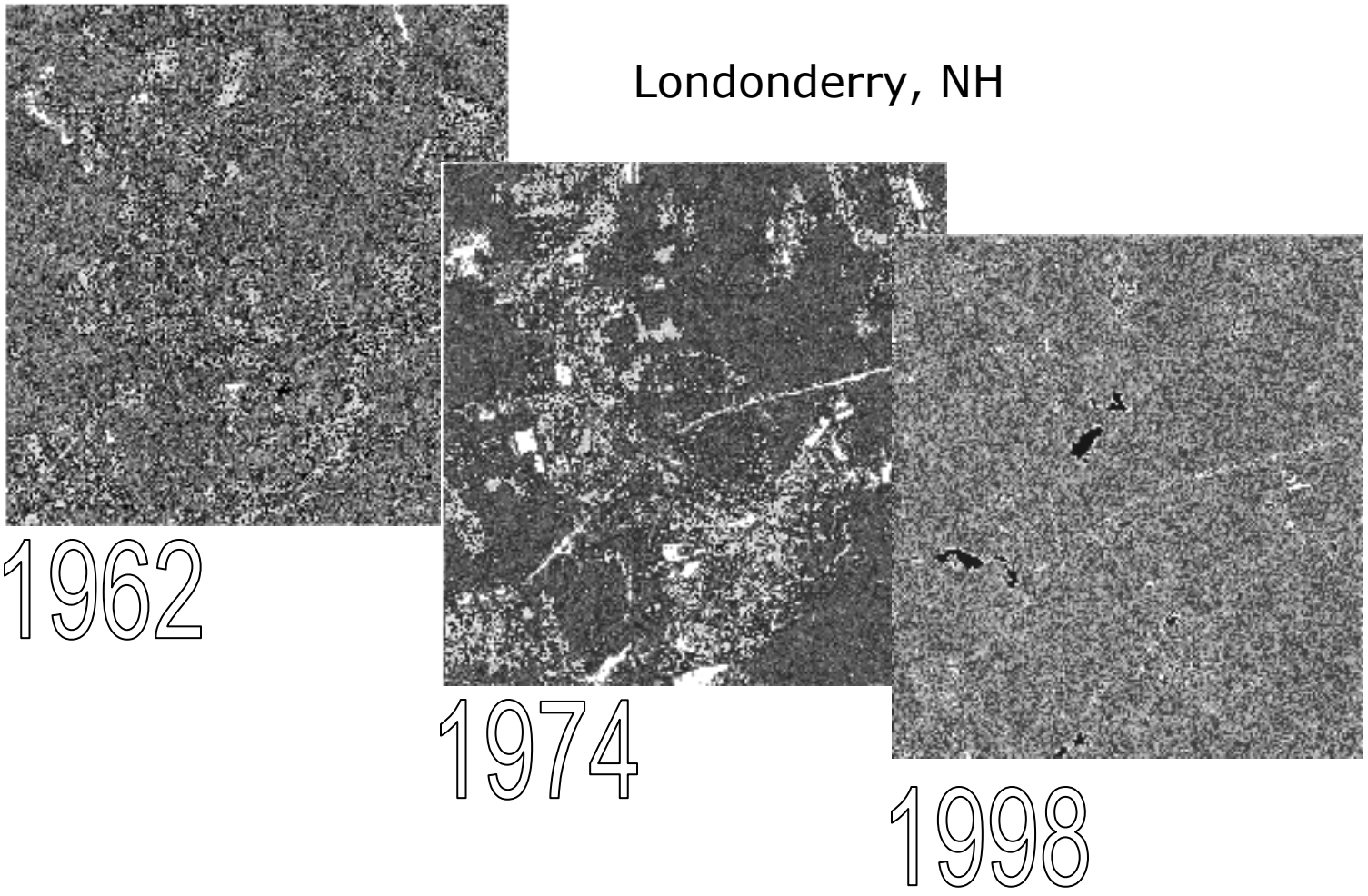
- Limitations:
  - 30-meter resolution
  - Useful for generalized mapping only
  - Canopy cover – masks scattered houses, etc.

2. Generalized Land Use

- Part of larger project to identify areas within the region subject to current and future development pressure: "Integrating Technologies to Monitor and Predict Patterns of Urban Growth"
- Land cover mapped from black and white aerial photography for 3 times periods – 1962, 1974, 1998
- Available for Rockingham and Strafford Counties
- Completed in 2005

Source Aerial Photography

Londonderry, NH



General Land Use Categories

- Residential - Individual houses, subdivisions, "in-town" residential areas
- Industrial/commercial - Urban areas dominated by business operations
- Mixed urban - Urban areas where commercial enterprise occupies part of a building/block and residential use occurs in another, adjacent part of the building/block. Also, miscellaneous urban uses, e.g. schools, military installations, etc.
- Transportation/roads - Paved roadways, travel lane width, airports, or other public transportation features
- Railroads - Railroad beds
- Auxiliary transportation - Highway medians, clover leafs, etc.
- Playing fields/recreational - Golf courses, baseball diamonds, football fields

- Agriculture - Hay fields, row crops, fruit orchards, etc.
- Farmsteads - Buildings associated with farms
- Forested - Land where trees are the dominant cover
- Water - Open surface water
- Open wetlands - Wetlands where dominant vegetation is < 20' high
- Idle/other open - Cemeteries, gravel pits, quarries, old fields

Results - 1962

1974 Land Use

Urban Classes
- Residential
- Industrial/commercial
- Mixed urban
- Transportation/roads
- Railroads
- Auxilliary transportation
- Playing fields/recreation

Agricultural Classes
- Active agriculture
- Farmsteads

Natural Communities
- Forested
- Water
- Open wetlands

Other
- Idle/other open

Results - 1974

1974 Land Use

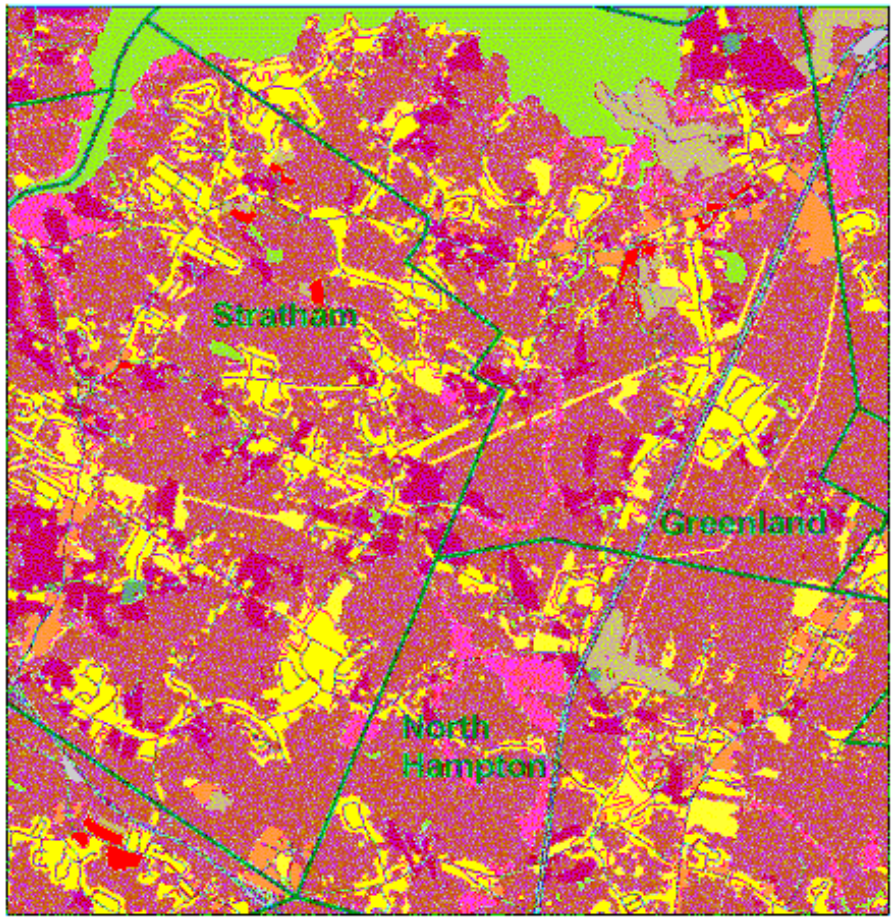
Urban Classes
- Residential
- Industrial/commercial
- Mixed urban
- Transportation/roads
- Railroads
- Auxilliary transportation
- Playing fields/recreation

Agricultural Classes
- Active agriculture
- Farmsteads

Natural Communities
- Forested
- Water
- Open wetlands

Other
- Idle/other open

Results - 1998



1998 Land Use

Urban Classes
- Residential
- Industrial/commercial
- Mixed urban
- Transportation/roads
- Railroads
- Auxilliary transportation
- Playing fields/recreation

Agricultural Classes
- Active agriculture
- Farmsteads

Natural Communities
- Forested
- Water
- Open wetlands

Other
- Idle/other open

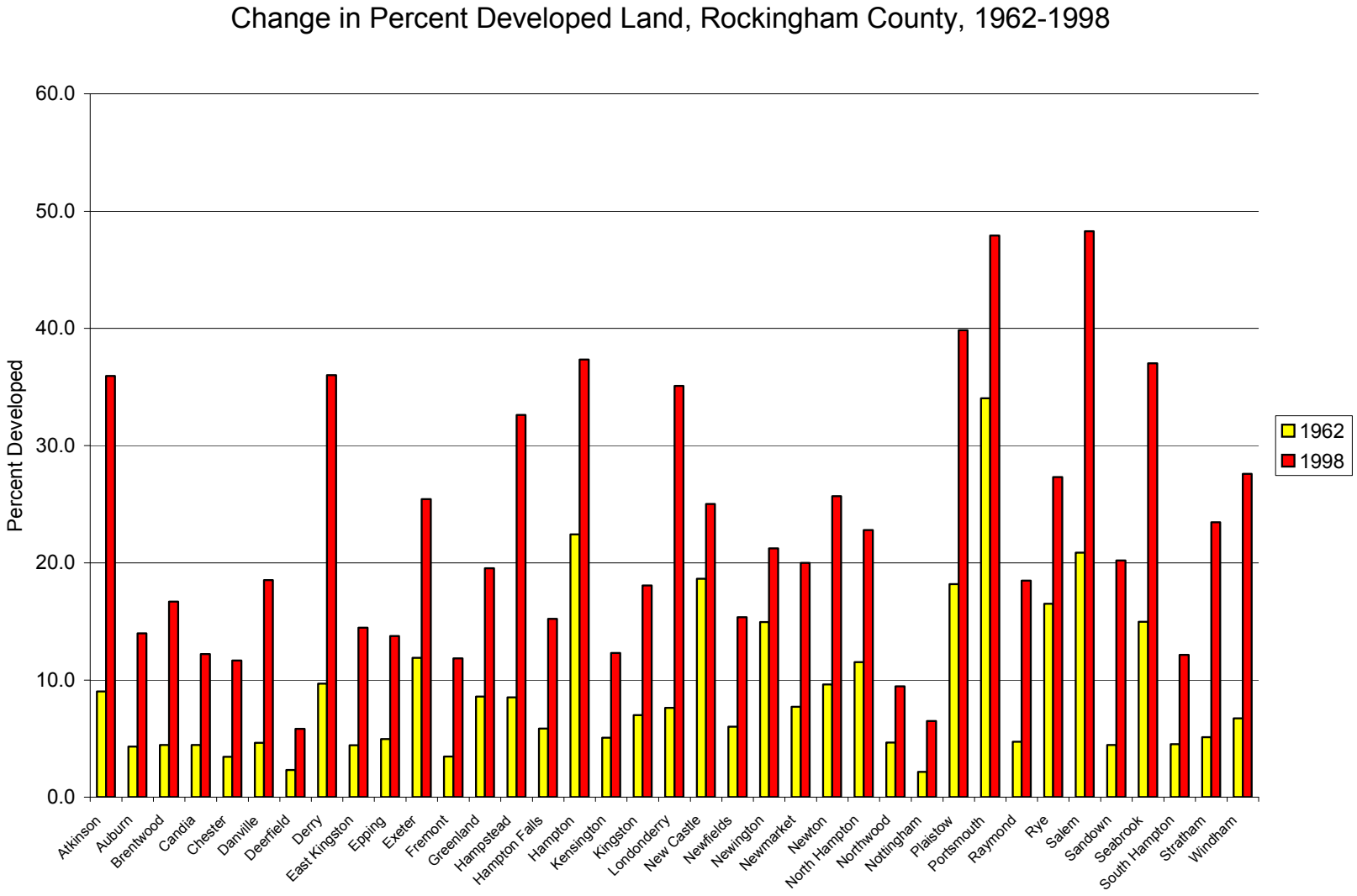
Land use class	Rockingham County (acres) 1962	% of Total	1974	% of Total	1998	% of Total
Residential	23,601	5.1%	35,665	7.7%	72,226	15.5%
Industrial/commercial	2,328	0.5%	4,857	1.0%	10,255	2.2%
Mixed urban	3,879	0.8%	3,943	0.8%	2,546	0.5%
Transportation/roads	5,068	1.1%	6,108	1.3%	8,522	1.8%
Railroads	377	0.1%	359	0.1%	348	0.1%
Auxiliary transportation	519	0.1%	1,037	0.2%	2,125	0.5%
Playing fields/recreational	747	0.2%	1,237	0.3%	2,399	0.5%
Agriculture	39,347	8.5%	26,528	5.7%	16,288	3.5%
Farmsteads	1,376	0.3%	1,064	0.2%	254	0.1%
Forested	338,853	72.9%	327,739	70.5%	295,980	63.7%
Water	19,620	4.2%	20,941	4.5%	22,784	4.9%
Open wetlands	14,567	3.1%	15,755	3.4%	15,011	3.2%
Idle/other open	14,700	3.2%	19,750	4.2%	16,246	3.5%
Total	464,982	100.0%	464,982	100.0%	464,982	100.0%

Summary of Developed Classes

	1962	1974	1998
Rockingham	7.9%	11.4%	21.1%
Strafford	6.2%	8.8%	13.8%
Total	14.1%	20.2%	34.9%

Land use class	Strafford County (acres) 1962	% of Total	1974	% of Total	1998	% of Total
Residential	8,172	3.3%	13,201	5.4%	22,804	9.3%
Industrial/commercial	785	0.3%	1,270	0.5%	2,188	0.9%
Mixed urban	1,205	0.5%	1,332	0.5%	1,468	0.6%
Transportation/roads	4,394	1.8%	4,836	2.0%	5,757	2.4%
Railroads	193	0.1%	174	0.1%	167	0.1%
Auxiliary transportation	141	0.1%	177	0.1%	317	0.1%
Playing fields/recreational	265	0.1%	461	0.2%	915	0.4%
Agriculture	21,870	8.9%	15,191	6.2%	11,012	4.5%
Farmsteads	832	0.3%	535	0.2%	474	0.2%
Forested	184,487	75.3%	181,929	74.3%	174,371	71.2%
Water	9,951	4.1%	10,276	4.2%	11,418	4.7%
Open wetlands	3,920	1.6%	4,807	2.0%	5,043	2.1%
Idle/other open	8,645	3.5%	10,672	4.4%	8,927	3.6%
Total	244,861	100.0%	244,861	100.0%	244,861	100.0%

Results by Town – Rockingham County



“Quick Facts” – Rockingham County

Change in developed land, 1962 – 1998:

- From 36,713 acres (7.9%) to 98,617 acres (21.1%)
- Increase of 61,905 acres, or 13.3% of the county

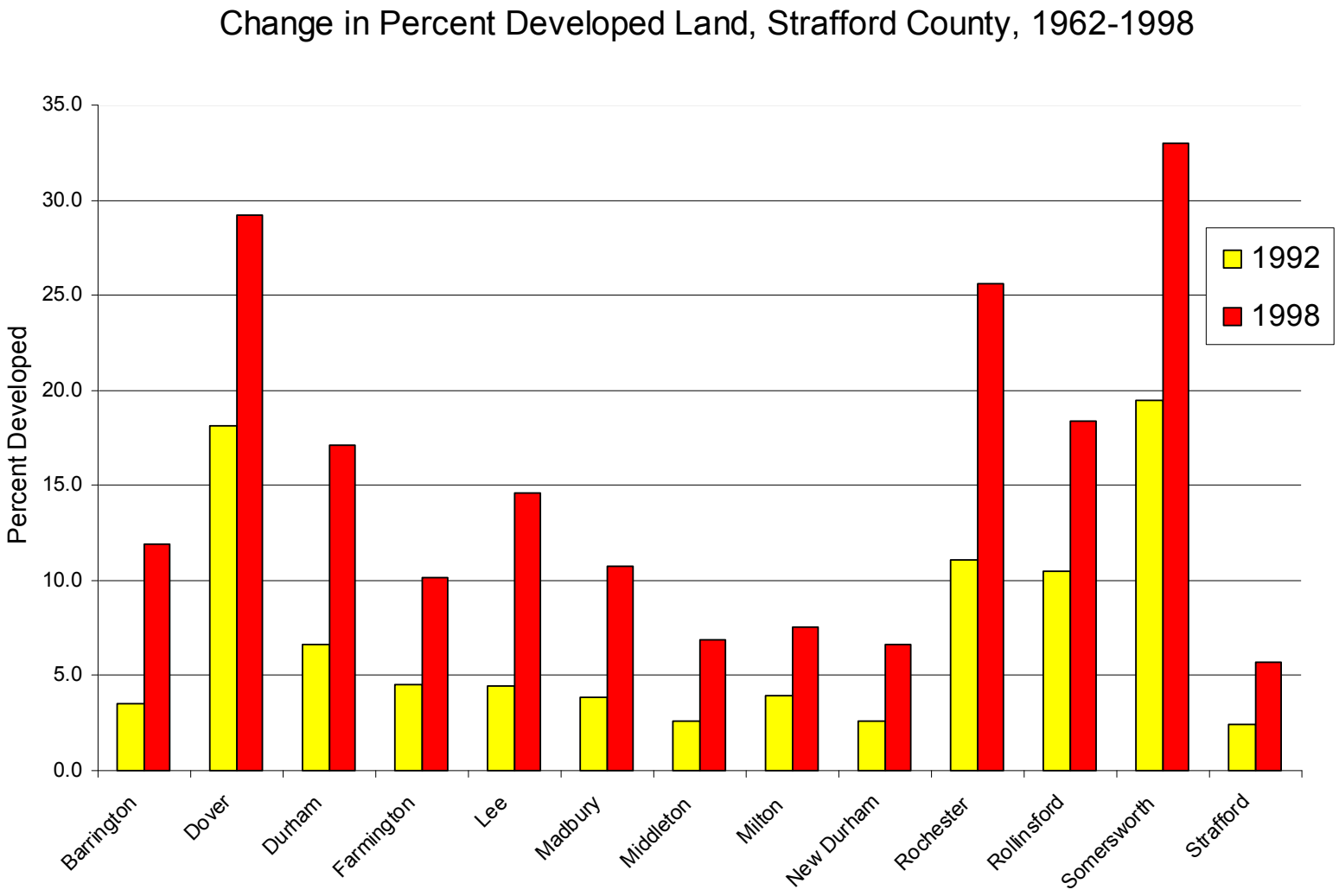
Of this acreage:

- 12,643 acres converted from agricultural uses
- 47,786 acres converted from forest

Towns with greatest % increase in developed acreage:

Londonderry	27.5%
Salem	27.4%
Atkinson	26.9%
Derry	26.3%
Hampstead	24.1%

Results by Town – Strafford County

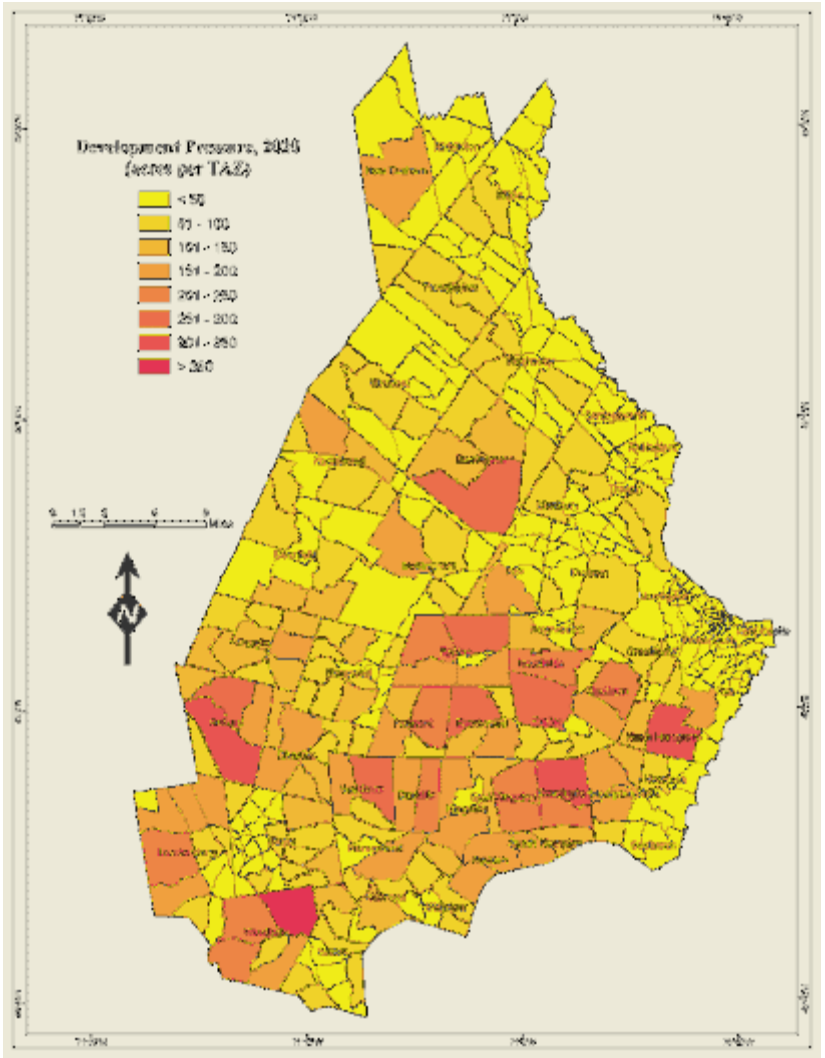


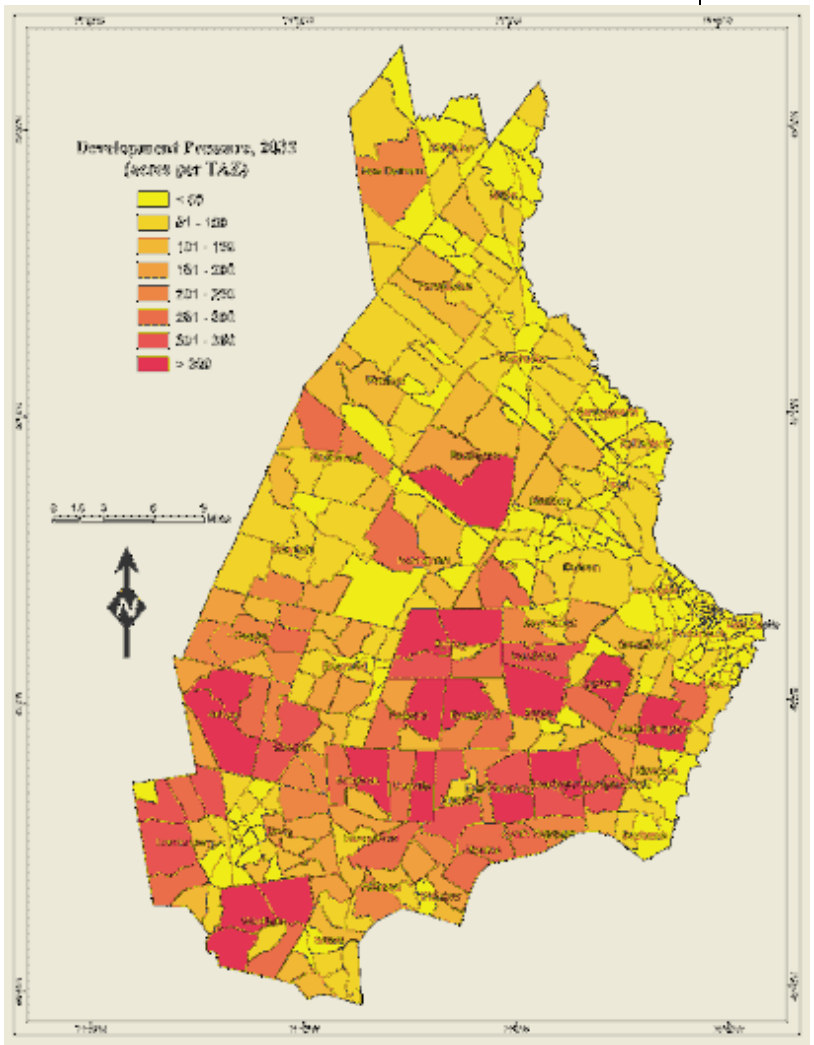
Generalized Land Use

- Strengths:
  - More detailed than land cover
  - Better able to map areas with low density development
  - Supports change detection over ~40 year period

- Limitations:
  - Still limited detail in mapping categories
  - Available for 2-county area only
  - Expensive to develop historical data

Modeling Development Pressures



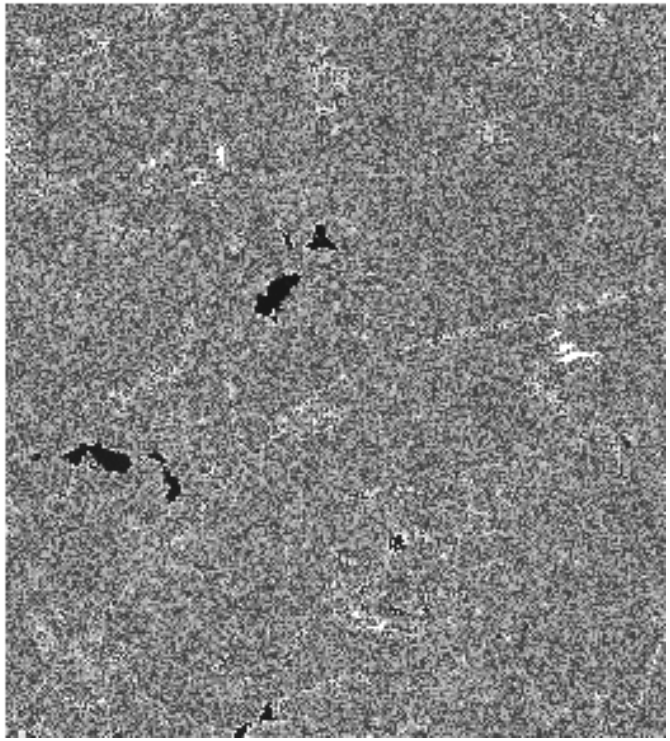


3. Detailed Land Use - 2005

- Original impetus – I93 CTAP. Funding from NHDOT.
- Initial coverage – 26 towns in I93 corridor.
- Extended to balance of Rockingham County for new CICEET Project: "Integrating Geospatial and Web-Based Technologies to Improve Land Use Planning in Coastal New Hampshire"
- Ongoing expansion of coverage - SRPC

Source Aerial Photography

Londonderry, NH



1998

2005

Detailed Land Use Categories

Urban and Built-Up Land (1)		
	Residential (11)	
	1110	Multi-family, medium to high rise apartments and condominiums (4 or more stories)
	1120	Multi-family, low rise apartments and townhouses, but not duplexes (1 - 3 stories)
	1130	Single family/duplex
	1140	Mobile home parks
	1150	Group and transient quarters
	1190	Other residential
	Commercial, Services, and Institutional (12)	
	1210	Commercial retail
	1220	Commercial wholesale
	1230	Services
	1240	Lodging
	1250	Government
	1260	Institutional
	1270	Educational
	1280	Indoor cultural/public assembly
	1290	Other commercial, services, and institutional
	Industrial (13)	
	1300	Industrial
	1370	Mining
	Transportation, Communications, and Utilities (14)	
	1410	Air transportation
	1420	Rail transportation
	1430	Water transportation
	1440	Road transportation
	1441	Limited & controlled highway right-of-way
	1442	Road right-of-way
	1445	Park & ride lot
	1446	Parking structure/lot
	1447	Auxiliary transportation
	1449	Other road transportation
	1450	Communication
	1460	Electric, gas and other utilities
	1470	Water and wastewater utilities
	1480	Solid waste utilities
	1490	Other transportation, communications, and utilities
	Industrial and Commercial Complexes (15)	
	1510	Industrial park
	1520	Office park
	1530	Shopping mall
	1580	Other industrial complexes
	1590	Other commercial complexes
	Mixed Developed Uses (16)	
	1610	Multiple stories, residential in upper stories only
	1690	Other mixed uses
	Outoor and Other Urban and Built-Up Land (17)	
	1710	Outdoor cultural
	1720	Outdoor public assembly
	1730	Outdoor recreation
	1740	Cemeteries
	1790	Other outdoor and other urban or built-up land
	Vacant (18)	
	1800	Vacant Land

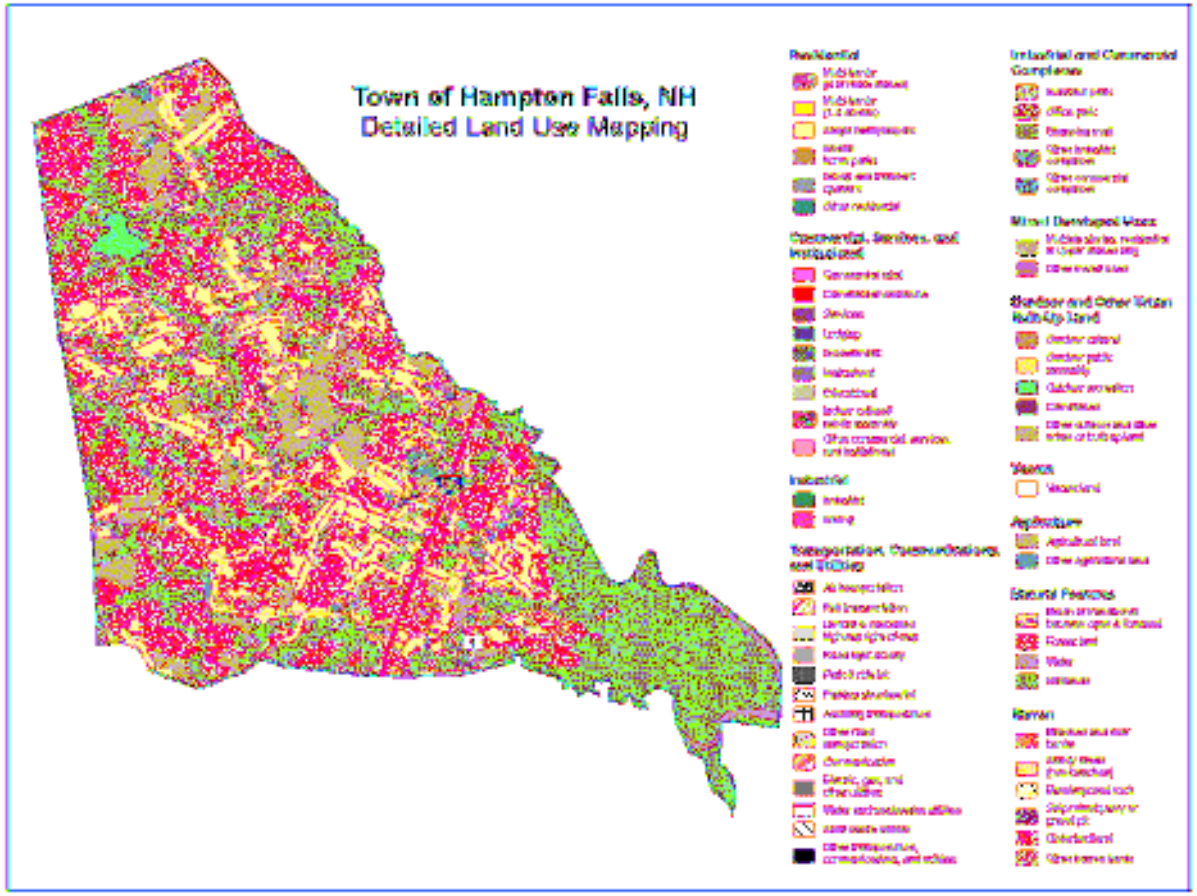
Agriculture (2)		
	2000	Agricultural Land
	2900	Other Agricultural Land
Transitional (3)		
	3000	Brush or Transitional Between Open and Forested
Forest (4)		
	4000	Forest Land
Water (5)		
	5000	Water (see 143 for transportation uses and 233 for agricultural uses)
Wetlands (6)		
	6000	Wetlands
Barren (7)		
	7100	Salt Flats
	7200	Beaches and River Banks
	7300	Sandy Areas (non-beaches)
	7400	Bare/Exposed Rock
	7500	Strip Mine/Quarry or Gravel Pit
	7600	Disturbed Land
	7900	Other Barren Lands
Tundra (8)		
	8000	Tundra

59 land use classes:

45 developed

14 agriculture/forest/wetlands/barren

Preliminary Results



Detailed Land Use - 2005

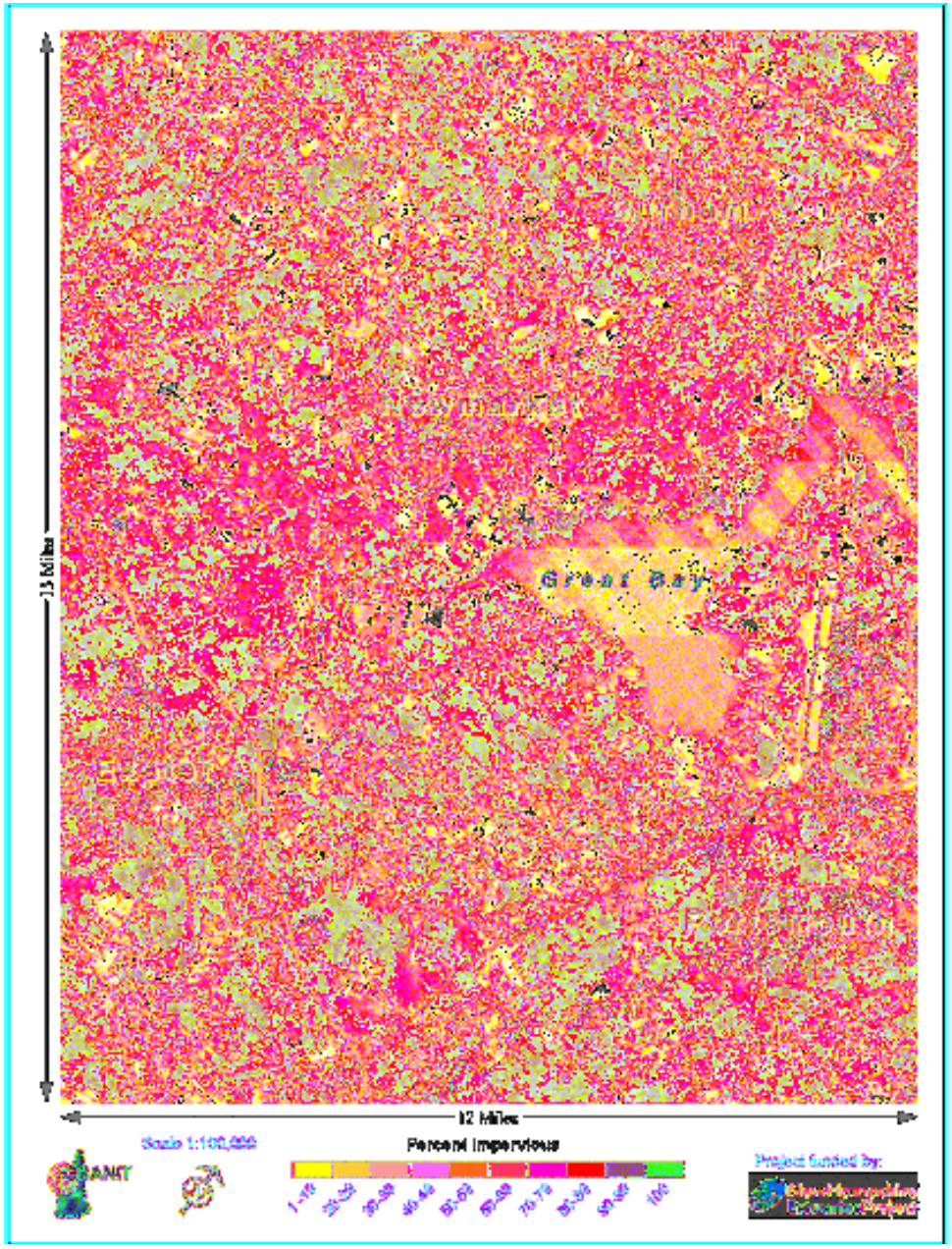
- Strengths:
  - Classification detail
  - Mapping resolution/detail
  - Can be aggregated to support trend analysis from generalized data (e.g. 1962-2005)

- Limitations:
  - Not yet available for entire coastal watershed
  - Expensive to acquire source imagery and develop data

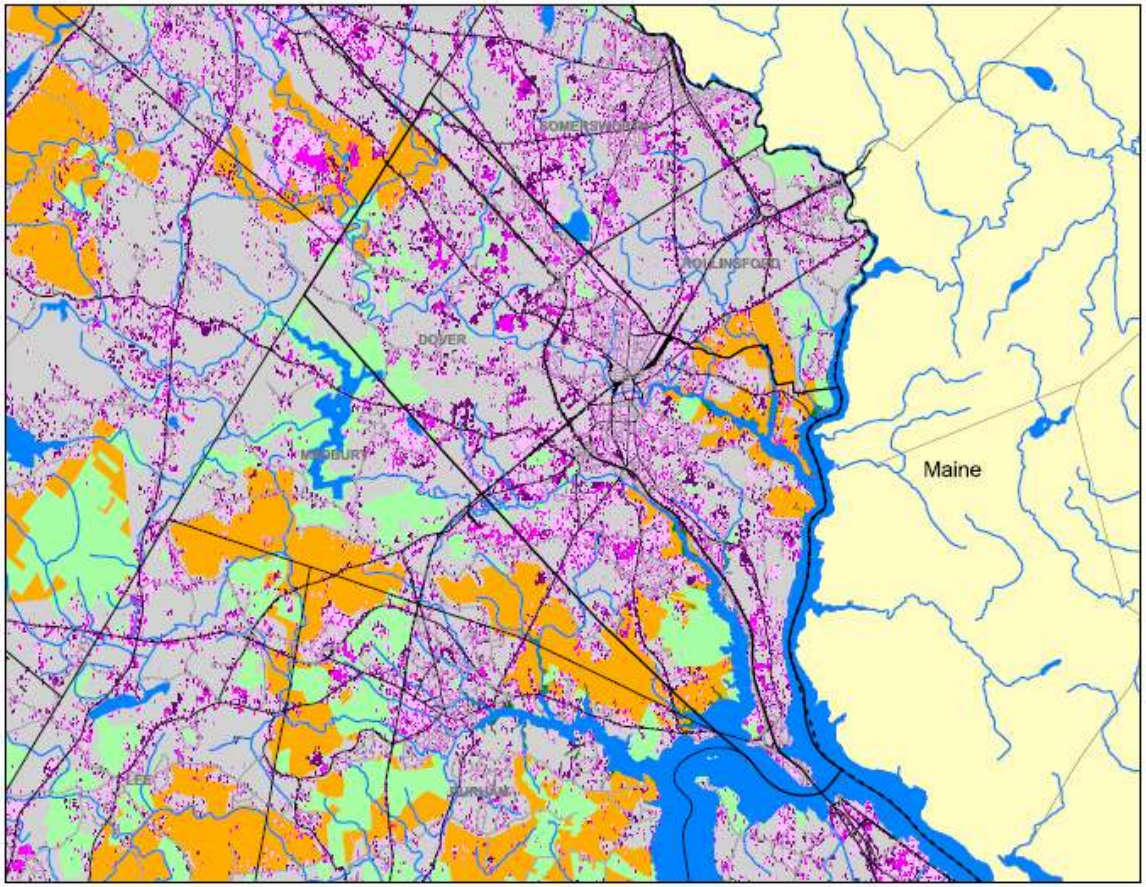
4. Impervious Surface Mapping

- Based on subpixel-processing of 30-meter Landsat Thematic Mapper imagery
- Result - % of pixel that is MOI in 10% increments
- Data currently available for 1990, 2000, and 2005
- Geographic coverage – coastal watershed
- Data development funded by NHEP

Impervious Surface Data – 1990



Impervious Surfaces and Conservation Areas in Dover, New Hampshire



Impervious Surfaces (IS)
- IS present in 1990
- IS added between 1990 and 2000
- IS added between 2000 and 2005

Conservation Areas
- Conservation Lands
- Conservation Focus Areas (CFAs)

Boundaries and Features
- Rivers and Streams
- Lakes, Reservoirs and Tidal Waters
- Tidal Wetlands

Roads
- Interstate
- State
- Local
- Railroads
- NH Towns
- MA or ME Towns
- State Boundary
- Selected Town Boundary

NOTES:
1. Conservation and Public Lands developed and maintained by NH GRANIT (updated 12/31/05).
2. Conservation Focus Areas (CFAs) were developed by The Nature Conservancy in the Land Conservation Plan for New Hampshire's Coastal Watersheds (2006, available at www.nhepunh.edu). CFAs are areas of high ecological value.
3. The rivers, lakes and estuaries on this map are the 305(b)/303(d) Assessment Units used by the NH Department of Environmental Services. The layer is based on the National Hydrography Dataset (1:100,000 scale).
4. Road data was provided by the NH Department of Transportation.
5. Impervious surface coverage provided by the UNH Complex Systems Research Center. Colored pixels represent areas estimated to be >30% covered by impervious surfaces. Each pixel represents a 30m x 30m area.

The coverages represented are under constant revision. NHEP is not responsible for the use or interpretation of this information. Not intended for legal purposes. Map prepared December 2006.

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Summary for Dover, NH	1990	2000	2005	Town Goal	Average Value*
Population (people)	25,042	26,884	28,776	NA	6,801
Impervious Surfaces (acres)	1,873	2,626	3,172	<1,709	1,083
Impervious Surfaces (% of land area)	11.0%	15.4%	18.6%	<10%	10.1%
Imperviousness per capita (acres per person)	0.075	0.098	0.110	<0.098	0.217

*Average value in 2005 for the 42 municipalities in New Hampshire's coastal watershed.

NewHampshire EstuariesProject

This map was produced by the New Hampshire Estuaries Project (www.nhepunh.edu) and was funded by the U.S. Environmental Protection Agency through an agreement with the University of New Hampshire. For more information contact the NHEP at 603-862-3403 or by email at ContactNHEP@unh.edu.

12-Digit HUC Subwatershed Name	Imp. Acres, 1990 (mid point)	% Imp., 1990	Imp. Acres, 2000 (mid point)	% Imp., 2000	Imp. Acres, 2005 (mid point)	% Imp., 2005	Change in % Imp., 1990 - 2005	Change in % Imp., 2000 - 2005
Alton Bay	698	2.4	929	3.2	1,145	3.9	1.5	0.7
Arlington Mill Reservoir	591	5.6	854	8.1	976	9.3	3.7	1.2
Axe Handle Brook	212	3.0	290	4.1	364	5.1	2.1	1.0
Bean River	256	1.7	374	2.5	462	3.1	1.4	0.6
Beech River	14	1.1	27	2.1	32	2.5	1.4	0.4
Bellamy River	1148	5.4	1,708	8.1	2,028	9.6	4.2	1.5
Berrys Brook-Rye Harbor	843	8.0	1,237	11.8	1,415	13.5	5.4	1.7
Big River	85	0.8	141	1.3	162	1.5	0.7	0.2
Bow Lake	121	1.5	185	2.3	217	2.7	1.2	0.4
Branch Brook	0	0.0	0	0.0	0	0.1	0.1	0.1
Cohas Brook	53	4.7	77	6.7	86	7.6	2.9	0.8
Crystal Lake	33	0.7	48	1.0	49	1.1	0.3	0.0
Great Bay	810	4.5	1,186	6.5	1,342	7.4	2.9	0.9
Great Brook-Exeter River	497	4.0	783	6.4	929	7.5	3.5	1.2
Hampton Harbor	1529	10.8	2,163	15.3	2,519	17.8	7.0	2.5
Headwaters-Great East Lake	168	1.9	247	2.8	288	3.3	1.4	0.5
Headwaters-Lamprey River	372	1.7	593	2.7	727	3.3	1.6	0.6
Junes Brook-Branch River	319	1.9	443	2.6	497	2.9	1.0	0.3
Little River (Exeter)	563	5.7	823	8.4	531	5.4	-0.3	-3.0
Little River (Lamprey)	289	2.3	446	3.5	1,001	7.8	5.6	4.3
Little River (Merrimack)	227	6.6	370	10.8	460	13.5	6.8	2.6
Little Suncook River	333	2.5	492	3.6	558	4.1	1.7	0.5
Long Pond	148	1.5	221	2.2	249	2.5	1.0	0.3
Lower Cocheco River	1502	9.3	2,080	12.9	2,535	15.8	6.4	2.8
Lower Isinglass River	803	5.6	1,184	8.3	1,339	9.4	3.8	1.1
Lower Lamprey River	521	4.0	768	5.8	831	6.3	2.4	0.5
Lower Salmon Falls River	296	9.7	379	12.4	436	14.3	4.6	1.9
Lower Spickett River	211	6.7	320	10.1	391	12.3	5.7	2.2
Lower Suncook River	30	0.9	42	1.3	44	1.4	0.4	0.1
Massabesic Lake	0	0.0	0	0.0	0	0.6	0.6	0.6
Middle Cocheco River	1267	8.0	1,685	10.6	1,912	12.1	4.1	1.4
Middle Lamprey River	1232	4.8	1,880	7.3	2,217	8.6	3.8	1.3
Middle Salmon Falls River	1094	7.0	1,536	9.9	1,929	12.4	5.4	2.5
Milton Pond	195	2.8	275	3.9	327	4.7	1.9	0.7
Moultonborough Bay	10	0.8	13	1.1	8	0.6	-0.2	-0.4
Nippo Brook-Isinglass River	266	1.6	374	2.2	453	2.6	1.1	0.5
North Branch River	255	2.3	393	3.6	459	4.2	1.9	0.6
North River	156	1.8	256	3.0	321	3.7	1.9	0.8
Oyster River	969	4.9	1,480	7.5	1,664	8.4	3.5	0.9

12-Digit HUC Subwatershed Name	Imp. Acres, 1990 (mid point)	% Imp., 1990	Imp. Acres, 2000 (mid point)	% Imp., 2000	Imp. Acres, 2005 (mid point)	% Imp., 2005	Change in % Imp., 1990 - 2005	Change in % Imp., 2000 - 2005
Pawtuckaway Pond	112	0.9	171	1.4	194	1.6	0.7	0.2
Pine River	191	2.2	281	3.2	311	3.5	1.4	0.3
Piscassic River	514	3.6	885	6.1	1,091	7.6	4.0	1.4
Pittsfield Tributaries	383	3.0	493	3.8	633	4.9	2.0	1.1
Portsmouth Harbor	2310	19.8	2,975	25.5	3,364	28.9	9.0	3.3
Powwow River	1075	4.4	1,661	6.8	2,022	8.3	3.9	1.5
Shapleigh Pond	185	4.3	254	5.9	298	6.9	2.6	1.0
South River	21	3.2	30	4.5	31	4.6	1.4	0.0
Spruce Swamp-Little River	649	4.5	1,023	7.1	1,179	8.2	3.7	1.1
Squamscott River	915	6.9	1,380	10.4	1,645	12.4	5.5	2.0
Sucker Brook	234	2.7	344	4.0	414	4.8	2.1	0.8
Taylor River-Hampton River	1157	8.0	1,745	12.1	2,145	14.9	6.9	2.8
The Broads	327	3.1	466	4.5	479	4.6	1.4	0.1
Towle Brook-Lily Pond	650	3.1	1,091	5.2	1,361	6.5	3.4	1.3
Upper Beaver Brook	1309	9.1	1,831	12.8	2,137	14.9	5.8	2.1
Upper Branch River-Lovell Lake	403	2.3	555	3.2	617	3.5	1.2	0.3
Upper Cocheco River	700	2.6	970	3.6	1,175	4.3	1.7	0.8
Upper Suncook River	56	1.6	77	2.2	98	2.8	1.2	0.6
Watson Brook	331	3.2	532	5.1	642	6.1	3.0	1.1
Winnicut River	778	7.0	1,190	10.7	1,381	12.4	5.4	1.7
Wolfeboro Bay	818	2.6	1,192	3.8	1,290	4.1	1.5	0.3
Total	31,233	4.3	45,445	6.3	53,408	7.4	3.1	1.1

1990-2000 – 2.0% total change
2000-2005 – 1.1% total change

13 of 60 subwatersheds exceed 10% impervious – impaired

Impervious Surface Mapping

- Strengths:
  - Time series of data
  - Repeatable, cost-effective

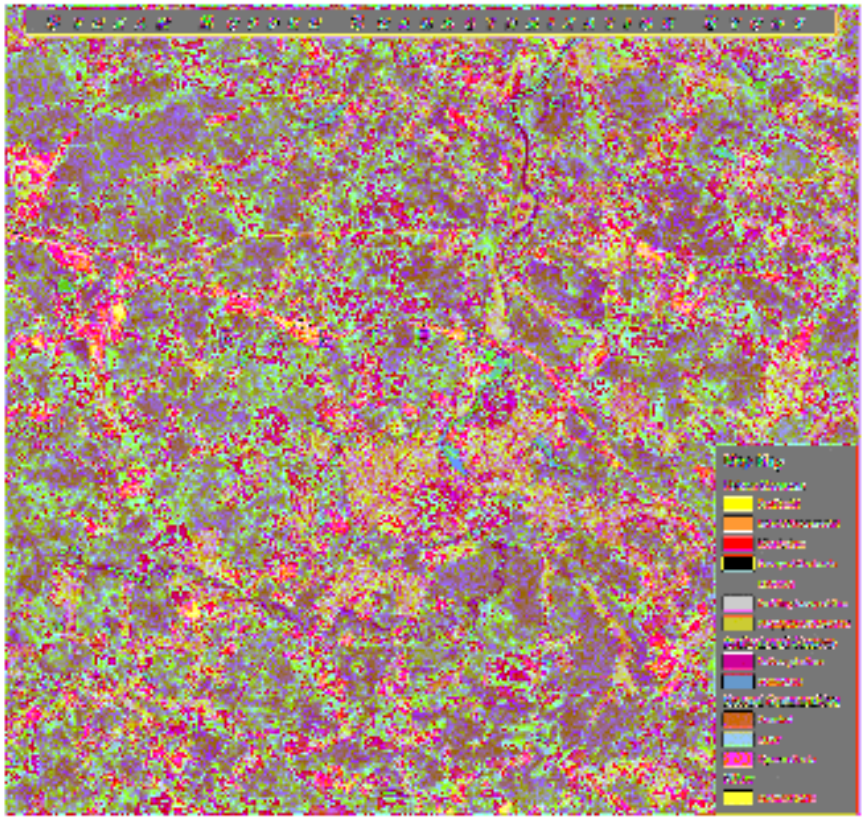
- Limitations:
  - Resolution of source imagery
  - Most appropriate for watershed-level estimates
  - Result is % of pixel that is impervious - not specific location of impervious surface

5. Stream Buffer Characterization Project

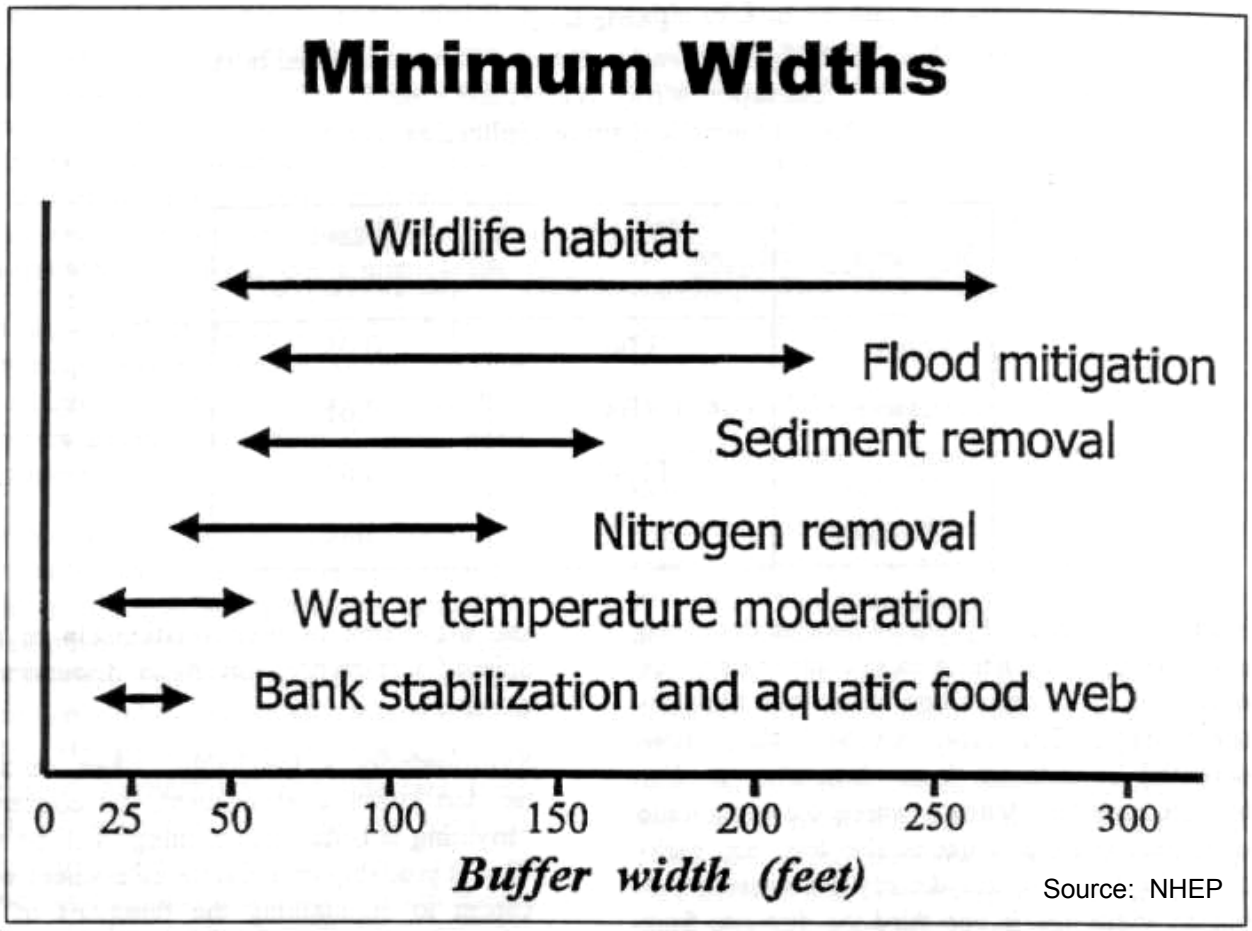
- Objective: Characterize 2nd order and higher streams to reflect the degree to which each stream has been impacted by human activity.
- Study Area: Piscataqua/Coastal Basin (759,673 acres)
- Data summarized and presented by town
- Completed July, 2006
- Project funded by NHEP

Data Sources

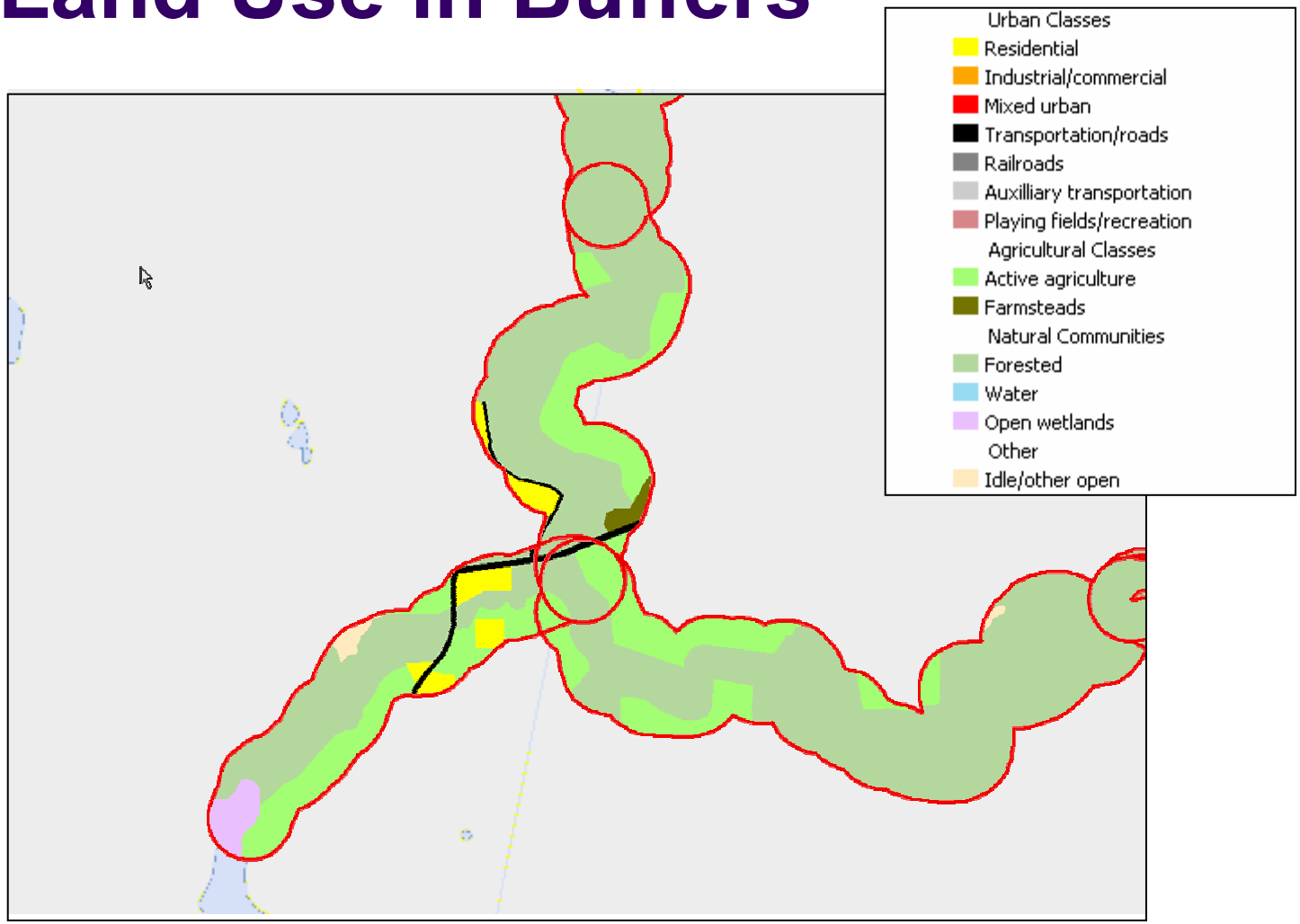
- Stream network – high resolution NH NHD dataset, with Strahler stream orders
- DOQs – 1:20,000, 1998
- Land use – derived from DOQs
- Impervious surfaces – 2005, derived from Landsat Thematic Mapper imagery
- Conservation/public lands – 1:24,000, updated April 2006



Buffer Generation



Land Use in Buffers



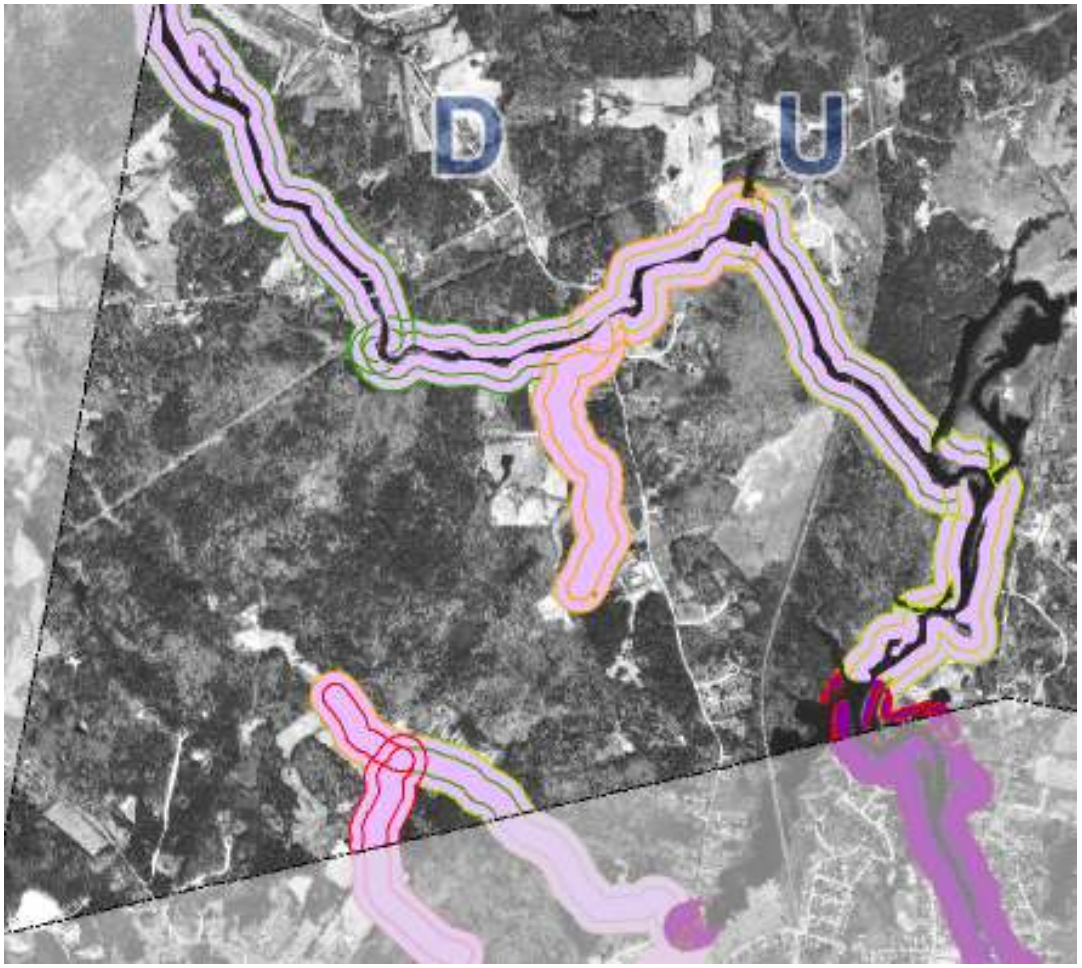
Oyster River along Durham/Lee town line

Assign Categories

Intact	<10% impacted[1]
Mostly Intact	10-25% impacted
Somewhat Modified	25-50% impacted
Altered	>50% impacted

[1]Includes the following land uses: developed (including gravel pits and quarries), transportation features, and agricultural land (including old fields and other cleared land).

Results of Characterization



Stream Buffer Characterization

- Intact
- Mostly Intact
- Somewhat Modified
- Altered

Percent Impervious by 300-ft Buffer Segment

- Less Than 10%
- Greater Than 10%

Conservation Lands

- Level 1, 2, or 2A

Results: 150' Buffers

Town Name	150' Buffer Area		Percent of Town Land Area Categorized as:				Percent of Buffer Acreage Categorized as:			
	Acres	% of Town	Intact	Mostly Intact	Somewhat Modified	Altered	Intact	Mostly Intact	Somewhat Modified	Altered
Alton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Barrington	1580.1	5.3	4.2	0.8	0.3	0.0	78.6	15.5	5.2	0.7
Brentwood	481.4	4.5	2.2	2.1	0.0	0.1	50.0	46.2	0.9	2.9
Brookfield	323.0	2.2	2.2	0.0	0.0	0.0	99.1	0.9	0.0	0.0
Candia	488.5	2.5	2.1	0.2	0.2	0.0	83.5	7.5	9.0	0.0
Chester	579.2	3.5	2.4	0.9	0.2	0.0	69.2	24.9	5.8	0.0
Danville	50.7	0.7	0.3	0.4	0.0	0.0	44.1	55.9	0.0	0.0
Deerfield	1038.2	3.2	2.5	0.5	0.2	0.0	78.1	15.8	6.0	0.1
Derry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dover	1085.8	6.3	2.3	2.0	1.3	0.7	36.8	31.4	21.0	10.8
Durham	689.7	4.8	1.2	1.7	1.5	0.4	24.3	35.9	30.5	9.2
East Kingston	208.8	3.3	2.3	0.7	0.4	0.0	68.6	20.4	11.0	0.0
Epping	1011.4	6.1	3.7	1.8	0.6	0.0	60.3	30.1	9.3	0.3
Exeter	931.1	7.4	3.7	1.8	1.2	0.6	50.1	24.8	16.6	8.5
Farmington	773.4	3.3	1.6	1.1	0.3	0.3	48.0	31.7	10.0	10.4
Fremont	564.6	5.1	2.2	1.7	1.0	0.2	42.9	34.0	19.9	3.2
Greenland	329.1	4.9	2.1	2.2	0.2	0.3	44.2	45.2	3.6	7.0
Hampstead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hampton	965.8	11.7	9.8	0.7	0.7	0.4	83.8	6.2	6.4	3.6
Hampton Falls	773.8	10.0	8.9	1.0	0.2	0.0	88.5	9.6	1.9	0.0
Kensington	370.4	4.9	3.2	0.7	0.7	0.2	66.5	15.5	14.9	3.2
Kingston	224.3	1.8	1.5	0.1	0.1	0.1	85.8	3.4	7.5	3.3
Lee	768.3	6.1	3.3	1.6	1.2	0.0	54.3	25.9	19.7	0.0
Madbury	387.0	5.2	3.2	1.9	0.0	0.0	61.4	37.2	0.5	0.9
Middleton	406.5	3.5	3.0	0.5	0.0	0.1	84.6	13.1	0.0	2.3
Milton	852.8	4.0	3.0	0.6	0.4	0.0	74.4	14.0	10.9	0.6
New Castle	145.1	28.7	3.3	0.0	0.0	25.3	11.6	0.0	0.0	88.4
New Durham	323.3	1.2	1.1	0.1	0.0	0.0	92.2	7.8	0.0	0.0
Newfields	293.3	6.5	4.4	1.4	0.4	0.3	67.5	21.7	6.8	3.9
Newington	178.0	3.4	0.4	0.5	1.3	1.1	12.5	15.4	39.3	32.8
Newmarket	457.9	5.7	2.8	1.2	1.1	0.7	48.8	21.0	18.7	11.5
North Hampton	490.2	5.5	3.9	1.3	0.1	0.2	70.4	23.5	2.1	4.0

Results: 150' Buffers

Town Name	150' Buffer Area		Percent of Town Land Area Categorized as:				Percent of Buffer Acreage Categorized as:			
	Acres	% of Town	Intact	Mostly Intact	Somewhat Modified	Altered	Intact	Mostly Intact	Somewhat Modified	Altered
North Hampton	490.2	5.5	3.9	1.3	0.1	0.2	70.4	23.5	2.1	4.0
Northwood	284.7	1.6	1.4	0.1	0.0	0.0	91.1	8.0	0.0	0.8
Nottingham	1408.7	4.7	4.1	0.5	0.0	0.1	86.7	10.2	0.5	2.6
Pittsfield	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Portsmouth	430.6	4.3	1.8	0.2	0.5	1.9	40.9	4.1	11.8	43.2
Raymond	1092.3	5.9	2.6	2.3	0.9	0.1	44.3	38.9	15.2	1.6
Rochester	1568.9	5.5	1.8	1.8	1.3	0.5	32.7	33.2	24.3	9.7
Rollinsford	296.1	6.3	3.2	0.0	2.8	0.3	50.8	0.0	43.8	5.4
Rye	554.3	6.9	4.7	1.1	0.5	0.7	68.2	15.5	6.8	9.5
Sandown	290.3	3.3	2.6	0.4	0.2	0.0	80.6	13.0	6.4	0.0
Seabrook	721.0	12.7	10.4	0.5	1.4	0.4	81.6	4.2	11.0	3.3
Somersworth	280.3	4.5	2.1	0.4	1.3	0.8	46.1	9.0	27.7	17.2
South Hampton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Strafford	690.7	2.2	2.1	0.0	0.0	0.0	95.2	2.0	1.6	1.3
Stratham	438.8	4.5	3.1	0.9	0.4	0.1	67.7	20.6	9.5	2.2
Wakefield	451.0	1.8	1.2	0.2	0.3	0.0	68.8	11.0	17.9	2.3
Wolfeboro	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**25279.5**	**3.6**	**2.3**	**0.7**	**0.4**	**0.2**	**63.5**	**20.2**	**11.1**	**5.2**

16.3% - modified/altered (>=25% developed/ag)

Results: 300' Buffers

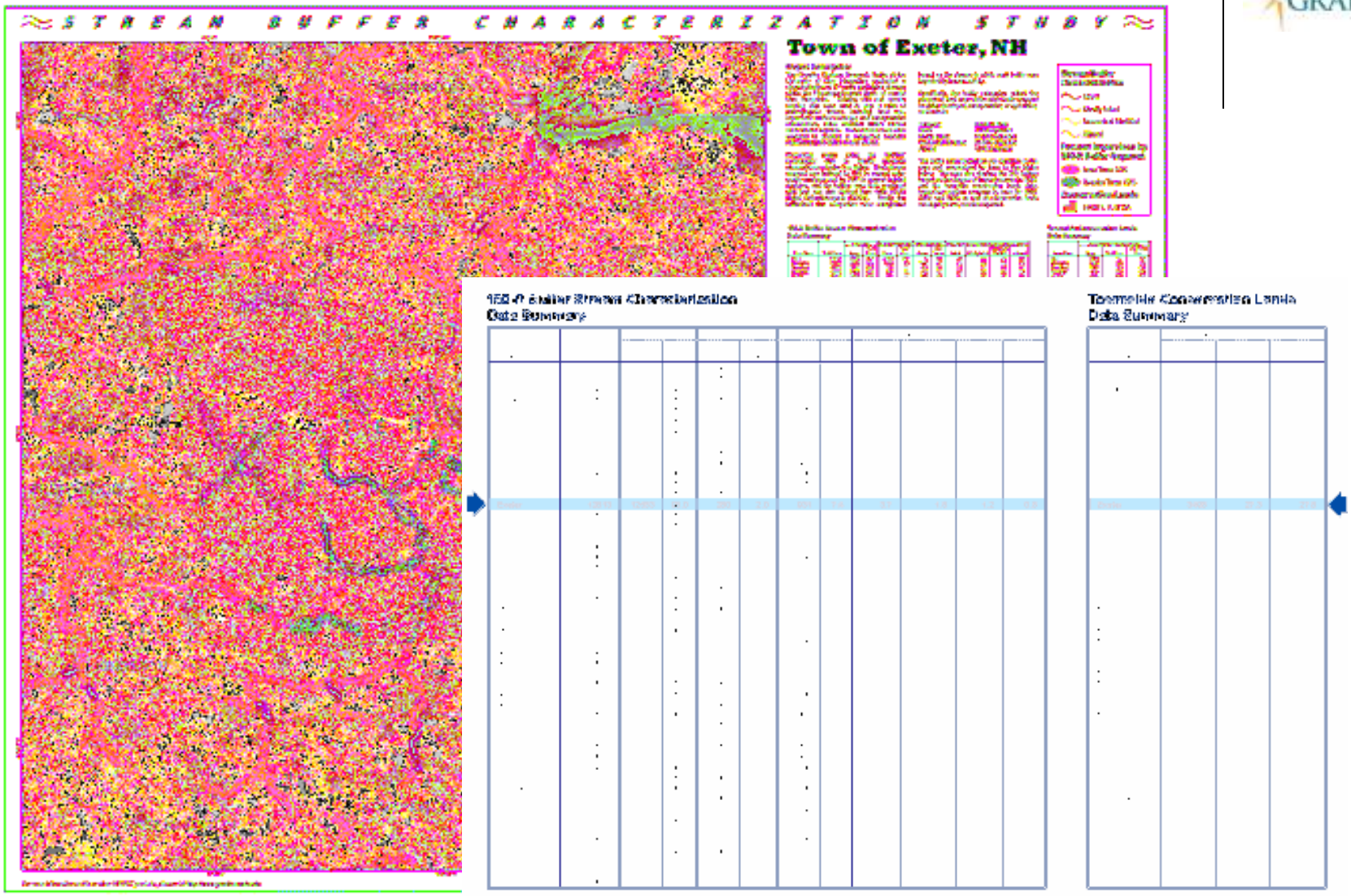
Town Name	300' Buffer Area		Percent of Town Land Area Categorized as:				Percent of Buffer Acreage Categorized as:			
	Acres	% of Town	Intact	Mostly Intact	Somewhat Modified	Altered	Intact	Mostly Intact	Somewhat Modified	Altered
Alton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Barrington	3210.2	10.8	7.2	2.6	0.8	0.1	67.0	23.9	7.7	1.4
Brentwood	958.0	8.9	2.2	5.8	0.5	0.4	24.5	64.7	6.0	4.9
Brookfield	646.6	4.4	4.1	0.3	0.0	0.0	92.7	7.3	0.0	0.0
Candia	1035.2	5.4	4.2	0.4	0.7	0.0	78.8	8.3	12.7	0.3
Chester	1205.2	7.3	3.4	2.3	1.5	0.0	46.8	32.0	21.2	0.0
Danville	98.2	1.3	0.6	0.7	0.0	0.0	43.3	56.7	0.0	0.0
Deerfield	2160.8	6.6	4.0	1.8	0.9	0.0	60.3	26.5	12.9	0.2
Derry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dover	2138.7	12.5	3.0	3.3	4.7	1.5	24.2	26.5	37.7	11.7
Durham	1376.8	9.6	1.5	1.7	4.9	1.5	15.6	17.4	51.2	15.8
East Kingston	416.5	6.6	2.4	2.1	1.2	0.8	37.2	32.4	18.6	11.9
Epping	1979.9	12.0	4.0	5.3	2.4	0.3	33.6	44.0	19.8	2.6
Exeter	1926.8	15.3	6.3	2.6	4.2	2.4	40.8	16.7	27.1	15.4
Farmington	1548.1	6.7	2.5	2.0	1.3	0.8	37.5	30.5	19.9	12.1
Fremont	1126.6	10.2	5.3	1.6	2.1	1.2	51.7	16.1	20.9	11.3
Greenland	670.1	9.9	2.0	5.6	1.6	0.8	20.1	56.3	16.0	7.7
Hampstead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hampton	2241.9	27.1	21.7	2.4	1.5	1.5	80.2	8.7	5.7	5.4
Hampton Falls	1751.6	22.7	16.9	4.4	1.3	0.1	74.7	19.3	5.6	0.5
Kensington	815.0	10.7	6.1	0.8	3.7	0.1	56.9	7.3	34.8	1.0
Kingston	457.6	3.7	2.7	0.5	0.3	0.1	73.6	14.6	7.8	3.9
Lee	1541.3	12.1	5.7	2.9	3.0	0.5	47.0	24.0	24.7	4.3
Madbury	745.3	10.1	3.7	5.0	1.2	0.1	37.2	49.4	12.4	1.1
Middleton	842.7	7.3	6.2	0.9	0.0	0.2	84.7	12.9	0.0	2.4
Milton	1758.9	8.3	6.0	0.8	1.3	0.2	71.9	10.0	16.2	2.0
New Castle	269.4	53.2	5.7	0.0	0.0	47.5	10.7	0.0	0.0	89.3
New Durham	703.0	2.7	2.5	0.1	0.1	0.0	92.6	3.4	4.0	0.0
Newfields	595.8	13.1	8.8	0.4	3.3	0.6	66.8	3.3	25.4	4.5
Newington	364.0	7.0	0.9	0.8	2.2	3.1	12.3	10.8	31.9	45.0
Newmarket	934.4	11.6	3.2	2.9	4.1	1.3	27.6	25.3	35.5	11.6
North Hampton	1027.7	11.6	5.9	3.3	1.7	0.6	51.0	28.6	14.9	5.4

Results: 300' Buffers

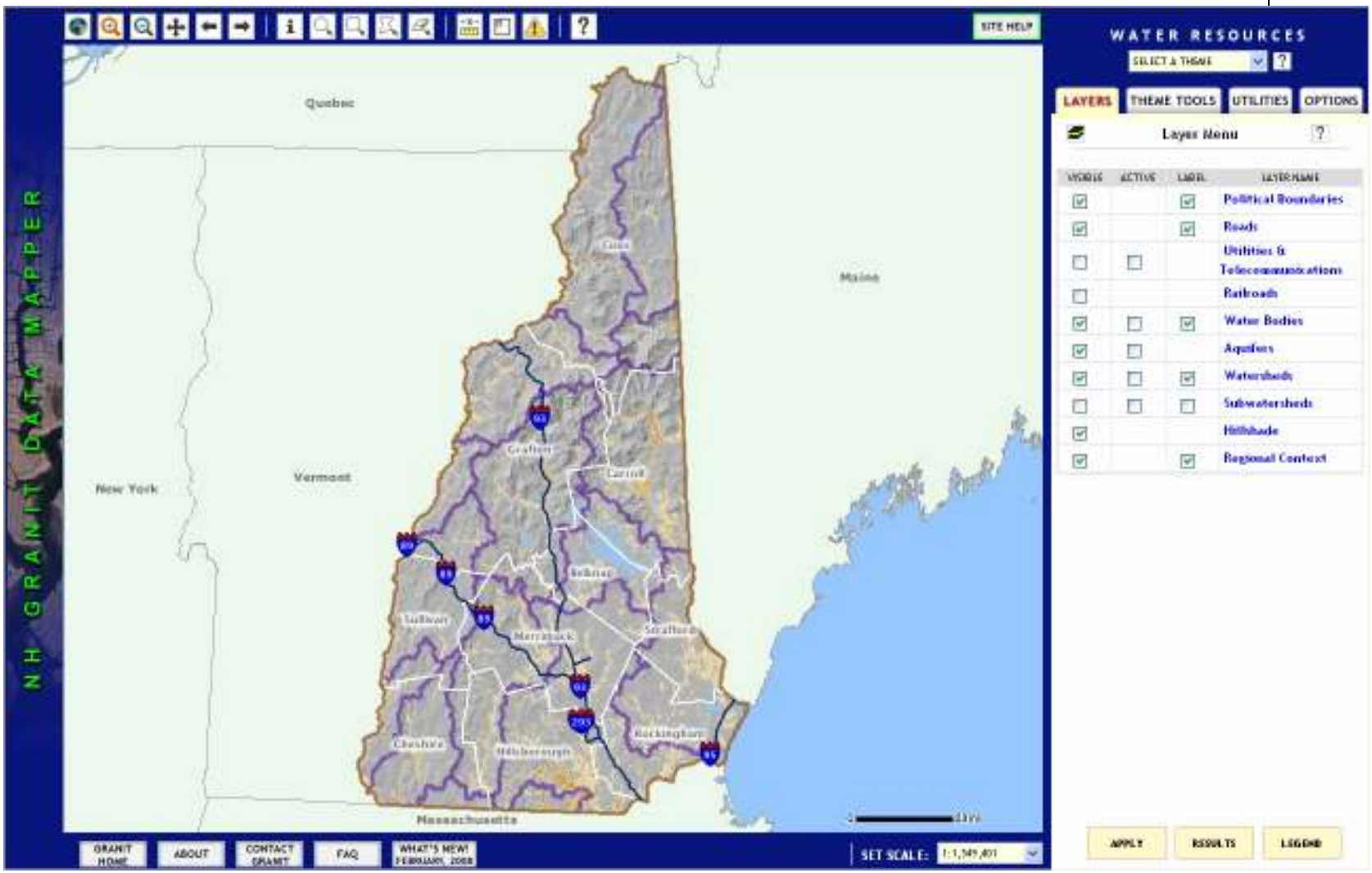
Town Name	300' Buffer Area		Percent of Town Land Area Categorized as:				Percent of Buffer Acreage Categorized as:			
	Acres	% of Town	Intact	Mostly Intact	Somewhat Modified	Altered	Intact	Mostly Intact	Somewhat Modified	Altered
Northwood	611.7	3.4	2.3	0.9	0.2	0.1	68.0	26.0	4.4	1.5
Nottingham	2927.8	9.8	6.7	2.6	0.2	0.3	68.3	26.3	2.3	3.0
Pittsfield	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Portsmouth	857.7	8.6	3.4	0.4	0.7	4.0	40.0	4.8	8.3	46.9
Raymond	2187.5	11.9	3.4	3.4	4.4	0.7	28.3	28.5	37.2	6.0
Rochester	3012.0	10.6	2.4	2.1	4.1	2.0	23.0	20.1	38.5	18.4
Rollinsford	581.9	12.4	3.1	3.0	3.4	3.0	24.7	23.8	27.4	24.1
Rye	1165.3	14.6	9.0	1.7	2.5	1.4	61.5	11.6	17.4	9.5
Sandown	599.5	6.7	4.2	1.7	0.8	0.0	62.9	24.9	12.2	0.0
Seabrook	1696.7	30.0	24.3	1.5	1.8	2.3	81.2	5.1	6.0	7.6
Somersworth	568.9	9.1	3.1	1.3	2.4	2.4	34.0	14.5	25.7	25.8
South Hampton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Strafford	1444.8	4.6	4.3	0.2	0.0	0.1	91.7	5.3	0.5	2.6
Stratham	889.4	9.2	4.5	2.4	2.0	0.2	49.5	26.6	21.6	2.3
Wakefield	947.5	3.8	2.2	0.8	0.6	0.2	58.5	20.4	16.4	4.7
Wolfeboro	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**52037.0**	**7.3**	**3.9**	**1.6**	**1.3**	**0.6**	**52.5**	**21.7**	**18.0**	**7.7**

25.7% - modified/altered (>=25% developed/ag)

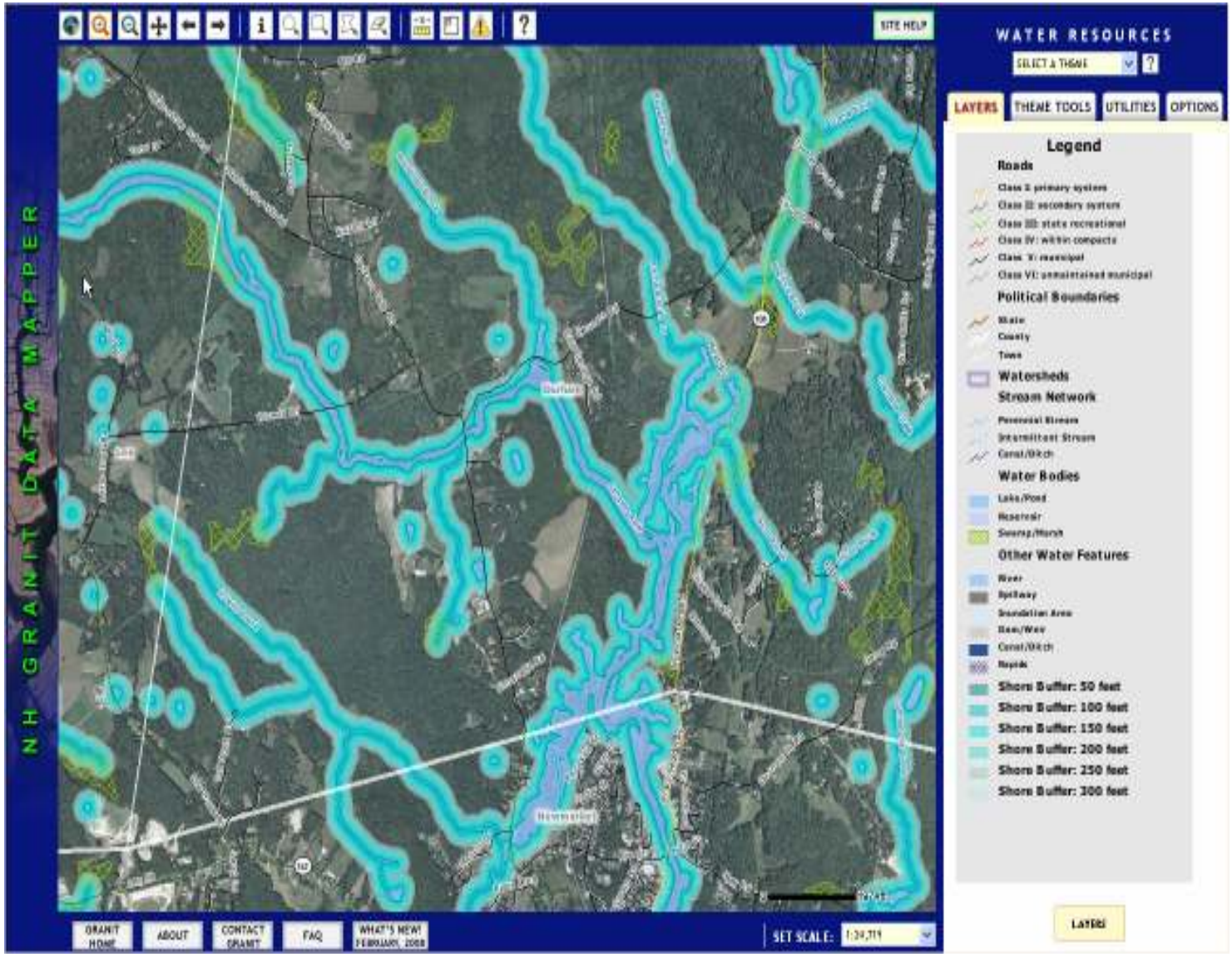
Sample printed map



GRANIT Data Mapper – mapper.granit.unh.edu



GRANIT Data Mapper



Questions?

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